DEHYDRATION OF PRAWNS IN TUNNEL DRYERS

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[This paper deals with the dehydration of prawns in a tunnel dryer. Conditions required to produce an end-product of desired colour, shape and texture as well as good reconstitution and organoleptic properties which are not obtained in the normal hot air drying, have been worked out. An initial temperature and relative humidity of 90°C. and 85% — 90% respectively and an air velocity not more than 1 metre/second are the essential conditions required. Both temperature and relative humidity are to be reduced to 70°C and 40% respectively after about an hour's operation, till the drying is complete. Flavour of the reconstituted product is close to that of the fresh cooked prawns and the texture is judged to be soft. Drying time required to reduce the moisture content of fresh prawns to 15% level is about 7 hours compared to 6 - 7 hours in normal hot air drying and more than 36 hours in sun--drying.]

Introduction

Prawns and other crustaceans contribute about 10% of the total marine landings in India (C.M.F.R.I., 1962). A good percentage of the prawns caught is processed into dried prawn pulp which forms an important item of export. Although the magnitude of the trade is sufficiently big, the industry is still organised on a cottage scale. The method commonly employed is to dry the prawns with the shell on in sun with or without subjecting them to preboiling in brine. The process, though it appears cheap has the disadvantages like the dependance on weather (bright sun is available in the coastal region only for a short time), the difficulty in obtaining a sufficiently low moisture content suitable for fairly long storage, contamination by flies and insects during the exposed drying, chances of spoilage of the material during the long period required for drying etc (Lekshmy, *et. al.,* 1964). The removal of the shell by beating after drying is not complete and also causes the breakages of the material. The product suffers further from poor reconstitution property, poor flavour and tough texture.

Chari, Pai and Venkataraman (Chari *et al.* 1946) ; Venkataraman *et. al.* 1953) have done some pioneering work on semi and hard-dried prawns. The semi-dried prawns, with its high moisture content, is unsuitable for storage and gets easily spoiled within a few days. The hard-dried prawns, dried after blanching in brine, suffers from certain defects, the most important of which are the brick-brown colour instead of the desirable carrot-like colour of the product, poor reconstitution property and the toughness of the texture.

It was, therefore, considered desirable to undertake the detailed studies with a view to evolving a method of dehydration which will give dehydrated prawns with the colour, shape and the texture as desired by the trade.

Materials and Methods

The dryer: Prabhu *et. al.* (1963) have described a tunnel dryer suitable for drying of fish. The same type of dryer with modifications to allow changes in the air-velocity

to different rates and also to have closer control on humidity was used in these experiments.

Marine prawns, mainly *M. dobsoni* (count 200-240 Nos. per Kg.) were used in these experiments. Prawns were caught by the trawlers operated by this Institute from the sea off Cochin and kept iced till used for drying.

Reconstitution: The reconstitution property of the dried prawns was determined by soaking 20 gms. of the dried prawns in 70 ml. of water at room temperature (29°C) for 3 hours, then drained over a mull cloth, adhering water removed with blotting paper and finding the increase in the weight. Organoleptic evaluation was made by cooking the dried prawns in salt water.

Results and Discussion

Preliminary investigations showed that the temperature, relative humidity and air velocity inside the dryer at different stages determined the colour and shape of the material. The typical colour of the dried prawns developed only when the prawns were dried in an atmosphere of certain temperature and humidity.

Experiments were conducted to find out the optimum conditions of temperature, relative humidity and air velocity for the production of dehydrated prawns of desired quality.

Table I shows the effect of relative humidity and temperature of the dryer on the quality of the final product.

TABLE — I. THE EFFECT OF RELATIVE HUMIDITY AND TEMPERATURE OF THE DRYER ON THE QUALITY OF THE FINAL PRODUCT

Tray loading	.....	1250 gm/sq. ft. (13.46 kg/sq. m.)
Relative humidity	.....	70% (throughout the drying period)
Air velocity	.....	0.75 m/sec.

No.	Relative humidity	Time required to reach 15% (wet basis) moisture in prawns (Hours)	Product quality
I.	80°C throughout the drying period	8.50	Uniform colour, curling not complete.
II.	90°C throughout the drying period		Product became pasty on touching after 2 hours.
III.	90°C for ½ hr. and 70°C for rest of the drying period	6.50	Uniform colour, curling not complete.
IV.	90°C for 1 hr. and 70°C for rest of the drying period	6.25	Uniform colour, curling not complete.

Since the drying period was longer with lower temperature of the order of 80°C, phased drying was employed and it was possible to cut down the time taken considerably. Samples I, III and IV showed good uniform characteristic colour, but lacked the proper curled shape characteristic of prawns dried after blanching.

TABLE — II. THE EFFECT OF RELATIVE HUMIDITY INSIDE THE DRYER ON THE QUALITY OF THE DRIED PRAWNS

Tray loading	.....	1250 gm/sq. ft. (13.46 kg/sq.m.).
Air Velocity	.....	0.75 m/sec.
Temperature	.....	90°C for 1 hr. and 70°C for the rest of the drying period.

No.	Relative humidity	Time required to reach 15% (wet basis) moisture in prawns (Hours)	Product quality
I.	70% throughout the drying period	6.25	Uniform colour, curling not complete.
II.	80% throughout the drying period	6.75	Uniform colour, curling more or less proper.
III.	85 — 90% for 1 hr. and reduced gradually to 40%	6.75	Uniform colour, curling more or less proper.

The final products were good from the point of view of colour, shape curling except in the case of sample I, which did not have the proper curling.

The effect of air velocity on the quality of the final product is given in Table III.

TABLE — III. EFFECT OF AIR VELOCITY ON THE FINAL PRODUCT.

Tray loading	.....	1250 gm/sq. ft. (13.46 kg/sq. m).
Relative humidity	.....	90% for 1 hr. and gradually reduced to 40%.
Temperature	.....	90°C for 1 hr. and 70°C for the rest of the drying period.

No.	Air velocity	Time required to reach 15% (wet basis) moisture in prawns (hours)	Product quality
I.	0.75 m/sec.	6.75	Uniform colour, curling more or less complete.
II.	2 m/sec.	5.75	Colour poorer than in sample I.

Prawns dried with air velocity 2 m/sec. was observed to have poorer colour than the other samples, probably due to the higher oxidation rate of the carotenoid pigment under the high rate of flow of air. Though it is possible to cut down the drying time by increasing the air velocity, it is not desirable as regards the colour of the material, since it determines, to a certain extent, the consumer acceptability of the products. This effect is, however, being studied in greater detail.

The effect of tray loading on the drying time required is shown in Table IV.

TABLE — IV. THE EFFECT OF TRAY LOADING ON THE DRYING TIME REQUIRED.

Temperature	.....	90°C for 1 hr. and 70°C for the rest of the drying period.
Relative humidity	.....	90% for 1 hr. and gradually reduced to 40%.
Air Velocity	.....	0.75 m/sec.

Tray loading	Time required to reach 15% (wet basis) moisture in prawns (Hours)
1000 gms/sq. ft. (10.76 Kg/sq. metre).	6.25
1250 gms/sq. ft. (13.46 Kg/sq. metre).	6.75
1500 gms/sq. ft. (16.14 Kg/sq. metre).	8.50

From the table it can be observed that a tray loading viz. 1250 gms/sq. foot can be considered to be optimum.

Organoleptic quality of the reconstituted product: The amount of water taken up by the samples prepared by soaking in water for 3 hours at room temperature (29°C) varied from 110% to 125% on the weight of the material. whereas the same for prawns dried after blanching in brine varied from 70% — 80% under identical conditions. The product was acceptable with regard to the colour; the flavour was close to that of the fresh cooked prawns. The texture was judged to be soft, whereas, blanched and dried prawns had a tough texture.

From the above observations, the following conditions are considered to be necessary for the porduction of dehydrated prawns in tunnel dryers.

(1) An initial higher relative humidity inside the dryer of the order of 85% — 90%, since prawns dried at atmosphere of lower humidity lacks the proper curled appearance. The relative humidity can be reduced later to accelearte the rate of drying.

(2) An initial high temperature of about 90°C inside the dryer for about an hour, when the development of the colour and the curling of the meat will be complete, after which it can be reduced since continuous drying at higher temperature will impair the quality of the product.

(3) A lower air velocity not more than 1 m/sec. for increase will result in poorer colour of the product.

(4) A satisfactory tray loading of 1250 gms/sq. foot can be considered optimum.

References

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Discussion

The Chairman stated that a complaint from countries importing our dried prawns is that they do not have a satisfactory colour.

Dr. A. N. Bose explained that the work being carried out at the C. I. F. T. is aimed at producing a dried prawn having the maximum colour. In this direction a considerable measure of success has been achieved. The Tunnel Dryer, mentioned by the author effects a quick drying of the product in less than seven to eight hours as against 32-36 hours in the sun and helps in retaining optimum colour. He also referred to the discovery recently made in the Institute that drying at high R. H. at phased temperature ranges in the tunnel produces the best colour in dry prawns.

The progress made in this field was very much appreciated by the Seminar, and the Fisheries Development Adviser suggested that a full scale pilot plant followed by a commercial plant should be constructed and trials taken as early as possible.

Dr. Bose informed the meeting that action in this direction has recently been initiated by the CIFT.